INDUSTRIAL ACCIDENT INVESTIGATION

SAFETY CASE

Fatal Crush Injury — Electric Overhead Travelling (EOT) Gantry Crane

Combined-Cycle Power Plant Construction Project

Elevated Gantry Workplace — Heavy Lifting Operations

Document type	Safety Case / Consolidated Accident Investigation Report
Prepared by	Industrial Accident Investigator (independent)
Subject event	Single-fatality crush incident involving a moving 140-tonne EOT gantry crane and a worker on foot, on an elevated gantry approximately 18 m above ground
Classification	Fatal accident — confined-clearance crush; concurrent (simultaneous) operations failure
Status	Consolidated analysis prepared from supplied investigation records; provisional where evidence gaps are noted
Confidentiality	Confidential — for safety review and organisational learning only

Anonymisation note: All personal names, company names, project names and specific site/location identifiers have been removed and replaced with generic role and organisational descriptors. The parties are referred to by function only — for example the Owner / Off-taker, the EPC Contractor, the Sub-contractor (employer of the deceased), the Third-Party Investigator, and the individuals by their job roles.

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1. Purpose, Scope and Basis of this Safety Case

This safety case sets out, from the standpoint of an independent industrial accident investigator, the circumstances, causation and corrective requirements arising from a fatal crush accident on an elevated crane gantry during the construction of a combined-cycle power plant. Its purpose is to establish what happened, why it happened at a systemic level, which barriers failed, and what must change to prevent recurrence.

The case is built by consolidating two independent investigations of the same event: an external investigation commissioned by the Owner / Off-taker and carried out by a Third-Party Investigator, and an internal root cause analysis carried out by the EPC Contractor whose management system was in force at the time. It applies structured analytical methods — a 5 Whys causal chain, Ishikawa (fishbone) cause categorisation, and barrier (Swiss-cheese) analysis — reconciles the two accounts, and maps corrective actions to each causal factor and to the hierarchy of control.

Status. The findings on systemic root cause are robust and corroborated by both source investigations. Following further investigation, the injury mechanism has now been established and the earlier supposition of pre-impact collapse is withdrawn (see Sections 2, 4 and 9).

2. Executive Summary

At approximately 09:50 on the day of the incident, a fire watchman employed by the Sub-contractor was fatally injured on an elevated gantry, approximately 18 m above ground, between two structural sections of the plant. He had left his fire-watch post and was leaning over the gantry handrail to observe the movement of a 140-tonne Electric Overhead Travelling (EOT) gantry crane, with his fall-protection lanyard hanging loose. The lanyard was drawn into the moving interface between the crane’s rolling wheels and the rail, dragging him down to the gantry floor. His loose-fitting harness rode up and the chest buckle lacerated the carotid, facial and occipital arteries. When the operator observed blood at ground-floor level and reversed the crane, the deceased was pulled further into the moving parts and his head became trapped between the outer edge of the handrail and the wheel hub. He was subsequently confirmed deceased at a local hospital.

Two investigations examined the event using different methods and were prepared by different parties. Both reached the same systemic conclusion. This convergence, from independent directions, materially strengthens confidence in the finding.

Consolidated root cause. The accident was caused by the absence of an effective control over simultaneous (concurrent) operations within the permit-to-work system. A heavy moving crane and personnel on foot were permitted to occupy the same physical zone at the same time, on separate permits that were never cross-referenced and without a task-specific risk assessment. This sat on top of a work-planning culture that prioritised schedule over safety. Individual actions did contribute to the outcome — the fire watch left his post and entered the danger zone with a loose, dangling lanyard, and the operator subsequently reversed the crane after seeing blood — but these were foreseeable behaviours that an adequate system should have prevented or contained through exclusion zones, PPE control, supervision and operator emergency training. The root cause therefore remains organisational and systemic; the individual factors were precipitating events made possible by the systemic gaps, not the underlying cause.

Proximate cause. Entanglement of the deceased's loose fall-protection lanyard in the moving wheel/rail interface of the EOT crane, drawing him into the crane's moving parts. The earlier supposition by the Third-Party Investigator that the deceased had collapsed and was unconscious before being struck is not supported by the further investigation: he was observed alive and standing, leaning over the handrail to watch the crane, immediately before the lanyard was caught.

3. The Two Investigations Compared

This safety case draws on two source documents that investigated the same event independently. Their attributes are compared below.

Attribute	Third-Party Investigation	EPC Contractor Internal RCA
Author	External investigator commissioned by the Owner / Off-taker	Internal team of the EPC Contractor
Independence	External and independent of the contractor	Self-assessment by the party whose system was in force
Stated method	Structured root cause methodology	Fishbone (Ishikawa) analysis
Stated root cause	Failure by the EPC organisation to implement contracted HSE procedures; permit-to-work system not fit for purpose	Inadequate procedure / work planning / permit-to-work / risk assessment; poor communication between affected parties; inadequate supervision

Key observation. The two reports converge on the same systemic root cause — inadequate permit-to-work control of concurrent operations — from independent directions. They differ on the described injury mechanism, the response timeline, and the completeness of each document. On the injury mechanism, both reports are now superseded by the further (revised) investigation, which establishes lanyard entanglement at the wheel/rail interface, with a subsequent crane reversal aggravating the injuries (Sections 4, 8 and 9).

4. Reconstructed Sequence of Events

The following timeline merges both accounts. Where the two sources differ on timing, both figures are shown. All persons are referred to by role only.

Time	Event
~07:00	Daily toolbox meeting held by the Sub-contractor supervisor and HSE representative. The EOT crane operator was not part of this engineering team and was not on the toolbox record.
6 days prior	EOT crane lift permit opened, valid through the day of the incident. The specific load to be lifted was not stated on the permit; no lift-specific risk assessment was attached.
Morning	A welder and the fire watchman were working as a two-man team from an elevated scaffold platform on the gantry, approximately 1 m below the crane rail, performing guard-rail welding and clean-up under work-at-height, hot-work and intervention permits.
Before 09:50	The fire watchman left his position and walked along the gantry toward the area where the EOT crane was positioned. The reason was not established (possibly to collect welding material).
~09:45–09:50	The EOT crane traversed toward the work area to pick up exhaust components / a fan. Having left his fire-watch post, the deceased was leaning over the gantry handrail watching the crane movement, with his fall-protection lanyard hanging loose. The lanyard was drawn into the moving interface between the crane's rolling wheels and the rail, dragging him down to the gantry floor. His loose-fitting harness rode up and the chest buckle lacerated the carotid, facial and occipital arteries. The welder to whom he was assigned as fire watch was several metres away, still welding, and was unaware the fire watch had left his post or that the incident had occurred until notified.
~09:50	The crane operator observed blood spatter at ground-floor level, stopped the crane and then moved it in the opposite direction. This reversal pulled the deceased further into the moving parts, forcing his head to become trapped between the outer edge of the handrail and the wheel hub. The operator then raised the alarm by shouting and the control unit was isolated. The project manager attended.
~09:55 / 10:06	First-aid response. EPC account: site nurse at 09:55. Third-party account: medic called at approximately 10:06. The casualty was recovered from the gantry by man-lift, assisted by an electrician and the welder.
~10:30	Casualty transported to a local hospital by ambulance.
~11:00 / 11:35	Death confirmed (EPC account: 11:00 reported to management; hospital medical report: death declared 11:35 after 45 minutes of CPR).
Afternoon	Police attended and took over the scene; the crime-scene team was on site for several hours. Police authorised cleanup, which was carried out later that day.

5. Causal Chain — 5 Whys

Working backward from the outcome to the systemic origin:

Why 1 — Why did the fire watchman die?

→ His loose lanyard was drawn into the crane's wheel/rail interface, pulling him down; his harness rode up and the chest buckle lacerated the carotid, facial and occipital arteries. A subsequent reversal of the crane trapped his head between the handrail edge and the wheel hub.

Why 2 — Why was he in the crane's path?

→ He had left his fire-watch post and was leaning over the handrail to watch the crane movement, with his lanyard hanging loose; no one was aware he had left his post or was in the danger zone.

Why 3 — Why was the crane moving where a man was on foot?

→ Lifting operations and gantry welding/access work were running simultaneously in the same physical zone, with no separation or exclusion.

Why 4 — Why were incompatible activities running together?

→ The four permits in force (work-at-height, hot work, intervention note, and EOT lift) were never cross-referenced; no controlling party recognised the conflict.

Why 5 — Why was the conflict never detected?

→ The permit-to-work system did not require cross-referencing, daily revalidation, or site verification of changing conditions, and no task-specific risk assessment was performed (only a generic pre-existing assessment existed).

Systemic root: Absence of a functioning simultaneous-operations (SIMOPS) control within the permit-to-work system, underpinned by a culture that prioritised production over safety.

6. Causal Factors by Category (Fishbone Logic)

Causal factors are organised into Ishikawa categories. The Management Systems branch is dominant — most other factors trace back to it.

A. Management Systems (dominant branch)

- Permits issued for a full week with no daily revalidation or re-signing.
- EOT lift permit not linked to the three work permits; actual load not specified; no lift-specific risk assessment attached.
- Multiple signatories across the permits, yet none questioned the concurrent operations in the same area.
- No permit log or register — the system could not be audited.
- Generic pre-existing risk assessment never translated into a task-specific assessment.

B. Supervision & Coordination

- Crane operator outside the engineering team and absent from the toolbox record — lifting and gantry work effectively managed as separate jobs.
- A single fire watchman expected to cover elevated welding; his movements were unmonitored.
- Poor communication between the relevant parties (identified in both reports).

C. Physical Environment & Barriers

- The gantry is a designed, authorised walkway approximately 1.2 m wide with a conventional guard rail (top rail, mid-rail and 150 mm toe-board) to its outer edge. There was no physical barrier separating the authorised walkway from the adjacent crane travel, and only ~150 mm (6 in) clearance between the crane and the rail — a contributing physical hazard that left no safe margin for a person at the rail.
- Conventional open guard rail (top rail, mid-rail, toe-board) left an open gap between rails through which a loose, dangling lanyard could pass and reach the crane wheel/rail interface. A meshed or solid-infill guard rail would have closed this gap; the guardrail design warrants a review (see Section 11).
- No safe access/egress (man-lift only); no welfare facilities.
- Poor housekeeping: cables coiled on the grating (trip hazard); uncontrolled loose bolts/steel (dropped-object hazard).
- Crane operated from a blind spot, noisy environment and absent safety signage.

D. People & Preconditions

- Fire watch left his assigned post unmonitored to observe crane operations, entering the danger zone; loose-fitting harness and unsecured, dangling lanyard created the entanglement hazard. (Earlier supposition of pre-impact loss of consciousness is withdrawn; the deceased was conscious and observing the crane when the lanyard was caught.)
- Worker fatigue / working hours flagged as a follow-up concern.
- Crane warning light and alarm did not prevent the deceased, who was deliberately observing the crane at close quarters, from being caught by the lanyard entanglement.

E. Emergency Response

- Presence of a downed worker on the gantry went undetected until blood was seen on pipework below.
- On seeing the blood spatter, the operator reversed the crane rather than isolating it in place; this movement aggravated the injuries by drawing the deceased further into the moving parts. No emergency stop / make-safe protocol governed the operator’s response on discovering a casualty.
- Response-timeline discrepancy between the two reports (see Section 8).

7. Barrier Analysis — Why Four Permits Stopped Nothing

Each permit was a paper barrier addressing its own activity in isolation. None functioned as a barrier against the interaction of activities — the hazard that actually materialised.

Barrier in place	Intended to control	Why it failed
Work-at-height permit	Fall hazards for the welding crew	Silent on adjacent crane operation; no SIMOPS clause
Hot-work permit	Fire / spark hazards from welding	Addressed welding only; no interaction with lifting
Intervention work note	Task authorisation / coordination	Not cross-referenced to the lift permit
EOT crane lift permit	Safe lifting operation	No reference to personnel working on the same gantry; load / RA not specified
Crane warning light & alarm	Alerting people near the crane	Did not deter the deceased, who deliberately approached to observe the crane; noisy environment
Toolbox talk	Briefing the day's hazards	Crane operator not included concurrent work not addressed

Swiss-cheese interpretation. The holes lined up because no single control was ever made responsible for the combined hazard of a moving crane and personnel sharing one elevated zone.

8. Consolidated Root Cause & Ranked Contributing Factors

Root cause. The proximate cause was the crane–pedestrian crush in a confined clearance. The root cause is organisational: there was no mechanism to detect and prohibit incompatible simultaneous operations, because the permit-to-work system lacked cross-referencing, daily revalidation, task-specific risk assessment, and SIMOPS rules — and because work planning treated schedule as the priority. Both investigations support this conclusion.

Contributing factors, ranked by leverage (i.e. how much eliminating each would have reduced the risk):

#	Contributing factor	Source
1	No SIMOPS control / permits not cross-referenced — the decisive systemic gap	Both reports
2	No task-specific risk assessment or method statement for the combined scenario	Both reports
3	Production-over-safety planning culture	Third-party
4	Inadequate physical separation — ~150 mm clearance and no exclusion zone, a contributing hazard once a person was at the rail	Third-party
5	Crane operated from a blind spot; noise and absent signage defeated warning	EPC RCA

#	Contributing factor	Source
6	Inadequate / indirect supervision; lone fire watchman; operator outside planning loop	Both reports
7	Poor housekeeping (coiled cables, loose steel) as a trip / dropped-object hazard on the elevated platform	Third-party
8	Unsecured dangling lanyard and loose-fitting harness drawn into the wheel/rail interface — the direct entanglement mechanism; aggravated by the operator reversing the crane after seeing blood	Revised investigation

9. Discrepancies Between the Two Reports

These differences do not undermine the shared root cause, but they matter for any follow-up and should be reconciled where possible.

- **Injury mechanism.** Both source reports are now superseded on this point by the revised investigation. The EPC RCA framed the event as the operator working from a blind spot with a noisy environment and absent signage. The third-party report proposed a harness strap catching the crane's leading edge and emphasised likely pre-impact unconsciousness. The revised investigation establishes a different mechanism: the deceased was conscious and leaning over the handrail watching the crane when his loose, dangling lanyard was drawn into the wheel/rail interface; his harness rode up and the chest buckle lacerated the carotid, facial and occipital arteries. The pre-impact unconsciousness supposition is withdrawn. A further aggravating factor, recorded for the first time, is that the operator reversed the crane after seeing blood, trapping the deceased's head between the handrail edge and the wheel hub.
- **Response timeline.** The EPC chronology is tighter and more favourable (crane moving 09:45; nurse 09:55; death reported 11:00). The third-party account and medic interview indicate alarm / response around 10:06–10:10, with death declared 11:35 in the hospital report. The two timelines do not fully reconcile.
- **Scene preservation.** The third-party report criticises removal of scene evidence before inspection. The EPC RCA explains the cause — the police crime-scene team attended and authorised cleanup — which partly accounts for, but does not fully resolve, the evidence gap.
- **Completeness.** The EPC RCA left cost-of-incident and direct / indirect cause fields marked under evaluation, and its corrective-action plan and fishbone diagram were transmitted as separate enclosures not included in the supplied file.

10. Evidence Gaps & Limitations

- No autopsy or final police report was available to the third-party investigator at the time of the original report. The mechanism by which the fire watchman came to be in the crane's path has since been established by the further investigation (lanyard entanglement while leaning over the handrail to observe the crane); the earlier supposition that he was unconscious before being struck is withdrawn. Confirmation against the autopsy and police findings should still be obtained where available.
- Physical scene evidence was removed (under police authorisation) before the third-party inspection; the analysis relies on photographs and a limited number of witness statements.
- The EPC contractor's fishbone diagram and corrective-action register were not included in the records supplied for this consolidation.
- The response-timeline discrepancy (Section 9) is unreconciled.

Conclusions about the systemic root cause are robust and corroborated by both investigations. The injury mechanism has now been established by the further investigation (lanyard entanglement, with aggravation caused by the crane being reversed), superseding the earlier provisional account; it should be confirmed against the autopsy and police findings where these are available.

11. Corrective Action Matrix

Each action is mapped to the causal factor it addresses (Section 8) and to the control hierarchy. Responsible parties and target dates should be confirmed by site management; placeholders reflect the functional roles named in the source documents.

#	Corrective / preventive action	Control type	Responsible	Target
1	Introduce a formal SIMOPS procedure: lifting and other activities in a shared zone require an exclusion zone or a documented, time-separated sequence. No lift permit issued where personnel work in the crane envelope.	Eliminate / Separate	EPC HSE + Project Mgmt.	Immediate
2	Mandate cross-referencing of all permits covering the same area; permits to list concurrent permits and be jointly authorised.	Administrative	Permit Controller	Immediate
3	Require a task-specific risk assessment and method statement, reviewed on site by the permit issuer before signing, for every critical activity.	Administrative	Area HSE Rep	Immediate
4	Limit permit validity to a single shift/day with daily revalidation and re-signing; maintain an auditable permit log; add a permit-audit section to the weekly HSSE report.	Administrative	EPC HSE	Near term
5	Establish physical separation between the authorised walkway and crane travel: barriers/interlocks or guarding to remove the unguarded gap. Commission a design review of the gantry guard rail, including replacement of the conventional top/mid-rail and toe-board with a meshed (or solid-infill) guard rail to close the open gap through which a lanyard could pass. Provide safe access/egress and welfare facilities.	Engineering	Project Engineering	Short term
6	Include the crane operator in toolbox talks for any area where the crane will operate; brief concurrent work to all parties.	Administrative	Supervisor / HSE Rep	Immediate
7	Reinforce crane warning systems (audible/visual) and add safety signage; assess noise controls. Do not rely on warnings as the primary control.	Administrative / PPE	EPC HSE	Short term
8	Enforce housekeeping on elevated platforms — route/secure cables, control	Administrative	Site Supervisor	Immediate

#	Corrective / preventive action	Control type	Responsible	Target
	loose bolts/steel as dropped-object hazards; pre- and post-work checks.			
9	Review working hours/fatigue management; implement behavioural-based safety review and stop-work authority awareness.	Administrative	EPC Management	Near term
10	Obtain and incorporate the autopsy/police findings; reconcile the response timeline; complete the cost and direct/indirect cause evaluation.	Investigation close-out	Investigation Owner	On receipt
11	Enforce correct fitting and management of fall-protection equipment: harnesses fitted snugly and lanyards kept short, clipped and stowed so they cannot dangle into moving machinery. Prohibit personnel from approaching or leaning over rails toward live crane travel; brief and supervise PPE use.	Administrative / PPE	Site Supervisor / HSE Rep	Immediate
12	Establish a make-safe / casualty-discovery protocol for crane and plant operators: on discovering a casualty or blood, stop and isolate the equipment in place and never move or reverse it. Train operators and include in toolbox briefings.	Administrative	EPC HSE / Crane Supervisor	Immediate

Note on hierarchy of control. Actions 1 and 5 (elimination/separation and engineering controls) carry the greatest weight. The numerous administrative actions are necessary but, as this event demonstrates, paper controls alone did not prevent the fatality — physical separation of crane and personnel is the priority.

12. Investigator's Conclusion

This was a foreseeable and preventable fatality. A worker on foot and a 140-tonne moving crane were authorised to occupy the same confined elevated zone at the same time, with only ~150 mm of clearance and no exclusion control — a physical hazard that left no safe margin for anyone at the rail. Four permits were live, several signatories were involved, and yet no single control owned the combined hazard. The defences that existed were aligned to individual tasks, not to the interaction between them — the classic latent condition behind major-accident events. The further investigation establishes the proximate mechanism: the fire watch left his post and leaned over the handrail to watch the crane with his lanyard hanging loose; the lanyard was drawn into the wheel/rail interface and dragged him down, and his loose harness buckle then lacerated major arteries. The injuries were aggravated when the operator, on seeing blood, reversed the crane and trapped the deceased's head against the wheel hub. Beyond the SIMOPS failure, this adds two further lessons: fall-protection equipment must be correctly fitted and secured so that lanyards cannot dangle into moving machinery, and operators must be trained to isolate and make safe — never to move equipment — on discovering a casualty.

The decisive lesson is that simultaneous-operations control cannot be left implicit. Where heavy lifting and personnel access coincide, the only reliable barriers are elimination of the overlap or hard physical/engineered separation; administrative permits, warnings and briefings are supporting measures, not primary controls. Until a SIMOPS regime and physical separation are demonstrably in place, comparable work should not proceed.

This safety case is issued to support corrective action and organisational learning. It does not constitute a legal determination of liability, and its provisional findings should be read alongside the autopsy and police reports when these become available.

13. Source Records (anonymised)

- Third-party fatal accident investigation report, prepared by an external investigator for the Owner / Off-taker.
- EPC contractor internal root cause analysis, with accompanying transmittal.
- Toolbox meeting record of the Sub-contractor for the day of the incident.
- Supporting appendices: permits to work, EOT crane inspection and operator certificates, medical report, witness interviews, and pathology representations.



Lead Investigator
Independent Accident Investigation Team

Date: [redacted]